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(54) PLASMA DISPLAY

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a plasma display having a black barrier necessary for enhancement of a contrast and color purity.
SOLUTION: A barrier having a stimulus Y in an XYZ color system within a range of 5 to 40 and chromaticity coordinates (x) and (y) within a range of 0.3 to 0.36, respectively, is prepared with paste composed of 5-25 wt.% in total of metal such as Ru, Mn, Ni, Cr, Fe or Co or an oxide thereof mixed with a glass material having a glass transition point of 450-550° C, a glass softening point of 500-600° C and a thermal expansion coefficient of 75-90 × 10-7/K.

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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] The plasma display characterized by being the plasma display in which the septum was formed on the substrate, and the stimulus values Y in the XYZ color system of this septum being 5-40.
[Claim 2] The plasma display according to claim 1 characterized by the chromaticity-coordinate shaft x of said septum and the value of y being 0.3-0.36, respectively.
[Claim 3] The plasma display according to claim 1 or 2 characterized by said septum consisting of glass ingredients which are 450-550 degrees-C [of glass transition points], 500-600 degrees-C [of glass softening temperatures], coefficient-of-thermal-expansion 75 - 90x10-7/K.
[Claim 4] The plasma display according to claim 1 to 3 characterized by said septum consisting of glass ingredients of the following presentation.
Lithium oxide : 3 - 10-% of the weight oxidation silicon : 10 - 30-% of the weight boron oxide : 20 - 40-% of the weight barium oxide : 2 - 15-% of the weight aluminum oxide : It is [Claim 5] ten to 25% of the weight. The plasma display according to claim 1 to 4 with which said septum is characterized by containing the metals or those oxides of Ru, Mn, nickel, Cr, Fe, or Co five to 25% of the weight in total.
[Claim 6] The plasma display according to claim 1 to 4 with which said septum is characterized by containing the metals or those oxides of Ru, nickel, or Co five to 25% of the weight in total.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the plasma display used for large-sized television, a computer screen, etc.
[0002]
[Description of the Prior Art] Since a high-speed display is possible for a plasma display panel (henceforth PDP) compared with a liquid crystal display panel and enlargement is easy, fields, such as OA equipment and a public-relations indicating equipment, are permeated, and the progress to the field of a high definition television etc. is expected very much.
[0003] With expansion of such an application, it is minute and the color PDP which has many display cels attracts attention. PDP makes the anode and the cathode inter-electrode which counter produce plasma discharge in the discharge space prepared between the front-windshield substrate and the tooth-back glass substrate, and displays by hitting to the fluorescent substance which established the ultraviolet rays generated from the gas enclosed in this discharge space in discharge space. In this case, it is a septum (it is also called an obstruction and a rib) in order to secure uniform discharge space at the same time it presses down the breadth of discharge to a fixed field and makes a display perform within a regular cel. It is prepared.
[0004] This septum is that size (line breadth, height, pitch), although formed in the shape of a stripe in many cases. It changes with engine performance of PDP. It is 1 in order to make PDP highly minute (i.e., in order to increase the number of pixels with a fixed screen size). It is necessary to make magnitude of a pixel small. In this case, although it is necessary to make the pitch between septa small, if a pitch is made small, since discharge space will become small and the spreading area of a fluorescent substance will become small, brightness falls. If it is going to realize 42 inches high-definition television (1920x1035 pixels) and 23 inches OA monitor (XGA, 1024x768 pixels), specifically, it is 450 micrometers about the size of a pixel. The septum with which it is necessary to make it magnitude and each color is divided is pitch 150micrometer. It is necessary to form. In this case, if the line breadth of a septum is large, discharge space cannot fully be secured, but it becomes difficult to raise brightness therefore for the spreading area of a fluorescent substance to become small.
[0005] The approach of calcinating and forming it, after making into predetermined height the process of such a septum in PDP printing an insulating glass paste in the shape of a pattern with screen printing, and drying it from the former, by repeating 10 times or more was taken. However, especially in the usual screen printing, when panel size is enlarged, there is a problem that alignment with the discharge electrode and the printing location of an insulating glass paste which are beforehand formed on the substrate is difficult, and location precision is hard to be acquired. And since flapping of a septum and its side-face edge section and turbulence of the skirt arose and the precision of height was not acquired by performing many superposition printings in order to obtain predetermined septum height, display quality worsened and there were troubles, like the yield with bad workability is low.
[0006] With large-area-izing of PDP, and high-resolution-izing, by the approach by such screen-stencil, manufacture of a high definition septum becomes difficult technically, and it is becoming in cost and disadvantageous by the high aspect ratio.
[0007] In JP,1-296534,A, JP,2-165538,A, JP,5-342992,A, and JP,6-295676,A, the approach of forming a septum with a photolithography technique, using a photosensitive paste as an approach of improving this problem is proposed. However, since the sensibility and resolution of a photosensitive paste are low and a high aspect ratio and a high definition septum are not obtained by these approaches, it is 80 micrometers. When processing the septum pattern of height which is exceeded, it is the processing process (spreading, desiccation, exposure, and development) of multiple times. Since it needs, the technical problem that a process becomes long occurs.
[0008] In the publication-number 8-No. 50811 official report, the approach of forming a septum by one exposure is proposed using photosensitive glass mull technique. However, by this approach, since the septum was white, when using for a plasma display and a plasma-address-liquid-crystal display, there was a problem that contrast ran short. Although the improvement in brightness is effective since there is a light reflex from a septum at the time of luminescence when this septum is white, although it is calcinated and the septum for plasma displays is formed, after pattern processing is carried out using an insulating glass paste or a photosensitive paste, contrast falls for the outdoor daylight reflection at the time of un-emitting light from a septum top face.
[0009] Moreover, the manufacture approach of the septum using the photosensitive paste containing a black pigment is proposed by JP,6-144871,A and JP,8-17345,A. However, there is a problem that many exposure is

needed, by this approach. Moreover, although it was added in order that this black pigment might raise pattern resolution, the hardening depth obtained by one exposure was insufficient for the black pigment in order to absorb light, and it had the problem that many exposure was needed. Moreover, it is not considered about the improvement in contrast depended black whenever the obtained septum is black.
[0010] Moreover, in order to improve contrast, the panel structure which forms a black septum on a front substrate was proposed, but since it was necessary to form separately that it is necessary to align the septum of a front plate and a tooth-back plate, the black septum of a front plate, and the white septum of a tooth-back plate, there was a fault to which a process becomes complicated. Furthermore, screen printing is used as the formation approach of a septum, and there was a problem which cannot be formed with a sufficient precision.
[0011]
[Problem(s) to be Solved by the Invention] The purpose of this invention is to offer the plasma display which has the black septum which can raise contrast.
[0012]
[Means for Solving the Problem] The plasma display of this invention is a plasma display in which the septum was formed on the substrate, is characterized by the stimulus values Y in the XYZ color system of the septum being 5-40, and includes the following desirable embodiment.
[0013] (a) The chromaticity-coordinate shaft x of said septum and the value of y should be 0.3-0.36, respectively.
[0014] (b) Consist of glass ingredients said whose septa are 450-550 degrees C of glass transition points, and 500-600 degrees C of glass softening temperatures and whose coefficients of thermal expansion are 75 - 90x10-7/K.
[0015] (c) Consist of glass ingredients of the following presentation of said septum.
[0016]
Lithium oxide : 3 - 10-% of the weight oxidation silicon : 10 - 30-% of the weight boron oxide : 20 - 40-% of the weight barium oxide : 2 - 15-% of the weight aluminum oxide : 10 - 25 % of the weight (d) Said septum should contain the metals or those oxides of Ru, Mn, nickel, Cr, Fe, or Co one to 10% of the weight in total. Especially, the metals or those oxides of Ru, nickel, or Co are desirable.
[0017]
[Embodiment of the Invention] Generally, as septum height of a plasma display, it is 80-170 micrometers. It is said that it is suitable and inorganic materials, such as glass and ceramics, are used as the quality of the material. In this case, by making the color of a septum layer into white, the light in which the plasma display emitted light can be reflected by the septum, and brightness can be raised. However, since the outdoor daylight which carried out incidence to the pixel which has not been turned on reflects when a septum is white, contrast falls, but if the color of a septum is made black, since reflection of outdoor daylight can be controlled, the contrast of a display can be raised.
[0018] As a color of the septum of this invention, it is effective in the improvement in contrast that the stimulus value Y makes it 5-40. In a value lower than 5, whenever [black] has the too high stimulus value Y, the effect of almost reflection is lost, and contrast comes to fall. Moreover, the stimulus value Y comes to wear gray in a value higher than 40, and contrast and color purity fall. Moreover, x at the time of asking for the chromaticity-coordinate value x and y and the value of y can raise the color purity of the luminescent color of a plasma display further by making it the value of the range of 0.3-0.36, respectively based on a tristimulus value XYZ.
[0019] The chromaticity coordinate x and y which are called for from the tristimulus value XYZ of the self-luminous color and them which are used by this invention are JIS. Z 8722 (measuring method of the object color), JIS Z8717 (measuring method of the fluorescence object color), JIS It can ask by the approach specified to Z8701 (the color specification approach by the XYZ color system and 10Y10ZX10 color coordinate system).
[0020] Generally as equipment which measures these stimulus values and chromaticity-coordinate values, the color computer by Suga Test Instruments Co., Ltd. can be used. The measured value of this invention is obtained using color computer SM-7-CH (optical condition 45-degree lighting, 0-degree light-receiving).
[0021] The test portion applied the photosensitive paste to the desiccation thickness of 50 micrometers on 80mm angle and the soda glass substrate with a thickness of 1.3mm, and at 580 degrees C, this was calcinated for 30 minutes and it produced it. It measured using this solid film baking sample, using a white plate (the thing of a barium sulfate, X= 91.06, Y= 93.01, and Z= 106.90 being used as a reference standard) as two C light (******) visual field and criteria. In advance of measurement, zero-point doubling was performed for the white plate only to the soda glass substrate in the sample base in piles. A test portion makes a baking sample side the optical direction of radiation, establishes it in the sample base which has the measurement hole of 12mmphi, and put the white plate on the glass substrate side in piles. The location of a test portion is changed, and measurement of three points is performed, and let the average be measured value.
[0022] The septum which has the black of this invention can be obtained by controlling strictly the class, amount, etc. of the class, content, and organic component of the photopolymer contained in the grain size, the configuration, the particle size distribution and the content of the glass powder under photosensitive paste, the metal which gives black-ization or the addition and class of a metallic oxide, and a photosensitive organic component. Moreover, since effect is delicately received in evaporation (debinder nature) of the organic component at the time of baking, burning shrinkage, etc., as for whenever [black], it is important for septum formation to choose glass powder, a black addition component, and an organic component, and to choose baking conditions.
[0023] In this invention, a septum can be black-ized by adding various metals or metallic oxides which were colored into the glass powder of a paste. That is, a desirable black septum can be formed by including preferably the metal

or metallic oxide of Ru, Mn, nickel, Cr, Fe, and Co five to 25% of the weight. Its affinity with a photopolymer component is good, and since the metal or metallic oxide of Ru, nickel, and Co can avoid a gelation reaction, it is desirable.
[0024] These metals or metallic oxides can be used by making glass powder adhere or cover. For example, after carrying out chemical plating of these metals on the surface of glass powder, powdered black-ization is attained by calcinating at 400-500 degrees C for 30 minutes to several hours. The desired metal salt or the water solution of a metal complex is made to distribute glass powder, and a reducing agent is specifically added in this distributed object, and by depositing a metal and calcinating it after that on a glass powder front face, a metal is oxidized and suppose that it is black.
[0025] When there are few additions of a metallic oxide, the powder of a metallic oxide adheres to a glass powder front face here and there in homogeneity. On the other hand, when there are many additions, it is covered by homogeneity, and a thin film is formed. Under the present circumstances, as glass powder used, it is desirable from the ease of covering that mean particle diameter is 0.5-5 micrometers.
[0026] Moreover, the metal made to adhere or cover is the inside of Ru, Cr, Fe, Co, Mn, and nickel with a black oxide, and at least 1. It is good to use beyond a seed. Although it will not be limited especially if the metal salt or metal complex used is the salt or complex of Ru, Cr, Fe, Co, Mn, and nickel and it is water solubility, a halogenide, a cyanide, a sulfate, a nitrate, an ammine complex, a nitrosyl complex, a carbonyl complex, and aqua complex are desirable, for example. for example, the case of Ru — 2RuCl2 (OH), 7NH3 and 3H2 O, and RuO2 2 (NH3) 2, 2 (NH4) RuO4, Ru(NO) Cl2 and H2 O, Ru(NO) Br2 and H2 O, and Ru(NO) I3 etc. — it is desirable.
[0027] Since the degree of sintering is excellent whenever black and, as for the black oxide adhered or covered, it is desirable that it is 5 - 25% of the weight of the amount of glass powder. It is 5 - 12 % of the weight more preferably. When fewer than 5 % of the weight, whenever [black] becomes weak, and gray cuts, it is visible, and there is little improvement effectiveness in contrast. Moreover, if [than 25 % of the weight] more, the softening temperature of glass will go up or it will become difficult to adjust a coefficient of thermal expansion with a glass substrate. moreover, a photosensitive organic component and a black oxide — reacting — paste viscosity — it gels [come] and is not desirable.
[0028] In this invention, to septum formation, a baking process is indispensable, and since both the glass substrates used in that case are heated, it is desirable that the heat softening temperature of the glass component which constitutes a septum is about 350-600 degrees C. In the case of less than 350 degrees C, when there is a problem which a septum layer transforms at a next sealing process and 600 degrees C is exceeded, there is a problem which becomes a septum layer with low reinforcement, without fusing at the time of baking.
[0029] The glass transition point and glass softening temperature of a glass component are a property in connection with the melting nature at the time of baking, and debinder nature, and since a coefficient of thermal expansion is related to substrate curvature, choosing in the following range is important for it.
[0030] The glass components which constitute the septum of this invention are conditions with important 450-550 degrees C of glass transition points, 500-600 degrees C of glass softening temperatures, and a coefficient of thermal expansion being 75 - 90x10-7/K. By setting the transition point and softening temperature of a glass component as the above-mentioned range, it becomes possible to perform the pyrolysis of the organic component in a baking process smoothly, and it can control black-ization of a septum.
[0031] It asks for the glass transition point and glass softening temperature which were shown here by differential thermal analysis. 100mg of test portions is extracted, this is heated with the programming rate of 20 degrees C/m, introducing Ayr, and a temperature (axis of abscissa)-heating-value (axis of ordinate) plot (DTA curve) is measured. A glass transition point and glass softening temperature are read in this DTA curve. Moreover, the coefficient of linear expansion of the point [distortion / high] glass used for a substrate is 80 - 90x10-7/K, by setting the coefficient of thermal expansion of the glass component which constitutes a septum as the above-mentioned range, it becomes possible to adjust an expansion coefficient and it can solve the problem of the curvature of a substrate.
[0032] In the paste which forms the septum of a plasma display or a plasma-address-liquid-crystal display, it is desirable to use glass powder 60% of the weight or more. It becomes [a degree of sintering may be checked at a baking process, the optimal burning temperature may rise, and the reinforcement of the formed septum may be insufficient, or] the cause of substrate curvature and is not desirable if it becomes less than 60 % of the weight.
[0033] It is as follows when the presentation of the glass powder preferably used by this invention is illustrated.
[0034]
Lithium oxide : 3 - 10-% of the weight oxidation silicon : 10 - 30-% of the weight boron oxide : 20 - 40-% of the weight barium oxide : 2 - 15-% of the weight aluminum oxide : Control of glass softening temperature and a coefficient of thermal expansion not only becomes easy, but it can make the average refractive index of glass low by using the glass powder which contains lithium oxide three to 10% of the weight in this way by this invention ten to 25% of the weight. In order that the addition of an alkali-metal oxide may raise the stability of a paste, 10 or less % of the weight is desirable, and is 8 % of the weight more preferably.
[0035] It is desirable to blend oxidation silicon in 10 - 30% of the weight of the range, when it is less than 10 % of the weight, compactness, and the reinforcement and stability of a glass layer fall, and a coefficient of thermal expansion separates from a desired value, and a mismatch with a glass substrate tends to happen. By carrying out to 30 or less % of the weight, there is an advantage, like softening temperature becomes low and baking to a glass substrate is attained.
[0036] As for boron oxide, it is desirable to blend in 20 - 40% of the weight of the range. If it exceeds 40 % of the

weight, the stability of glass will fall and a strong fall and the fall of the stability of glass will take place at less than 20 % of the weight.
[0037] Although the barium oxide is preferably used at 2 - 15 % of the weight, it becomes difficult to control glass baking temperature and electric insulation by less than 2 % of the weight. Moreover, if it exceeds 15 % of the weight, the stability and compactness of a glass layer will fall.
[0038] In order that an aluminum oxide may raise a point [distortion], it is added, but at less than 10 % of the weight, if the reinforcement of a glass layer falls and it exceeds 25 % of the weight, the heat-resistant temperature of glass will become high too much, and baking will become difficult on a glass substrate. Moreover, a precise insulating layer becomes that it is hard to be obtained at the temperature of 600 degrees C or less.
[0039] Although photosensitive mull technique and the sandblasting method are used in order the plasma display of this invention is highly minute and to form such a high aspect ratio and high definition septum pattern, especially photosensitive mull technique is suitable.
[0040] After photosensitive mull technique applies to predetermined thickness the photosensitive paste which consists of glass particles and a photosensitive organic component on a glass substrate and dries, it carries out pattern exposure, is developed, forms a septum pattern, and is an approach with them. [there are few routing counters and simple] On the other hand, after it applies the paste containing glass particles and dries, the sandblasting method applies a photoresist on it, to this, carries out pattern exposure and develops it. It is the approach of etching the paste layer which contains glass particles with sandblasting, using a photoresist as a protective coat, and forming a septum pattern. In this case, since a spreading process, the exfoliation process of a resist, etc. are added, a routing counter increases, or there is a problem of processing of the abrasive material used for sandblasting etc.
[0041] It is the pitch of 100-160 micrometers with photosensitive mull technique. Height of 100-170 micrometers In order to form a septum pattern, it is important to make the average refractive index of the glass component used and the average refractive index of a photosensitive organic component approximate as much as possible.
[0042] Although a photosensitive paste consists of the glass powder and the photosensitive organic component which have the presentation described previously, in order to form the black septum of this invention, the glass powder which adhered or covered the metal or metallic oxide which presents black is used.
[0043] A photosensitive organic component contains the photosensitive component chosen from at least one kind in a photosensitive monomer, photosensitive oligomer, and photosensitive polymer. Although there are a type which insolubilizes in an operation of light, and a type to solubilize as a photosensitive component and all are usable, as a photosensitive component which can mix with glass powder and can be used simple, an optical insolubilization type thing is desirable.
[0044] The photopolymerization initiator, the sensitizer, the ultraviolet ray absorbent, the polymerization inhibitor, the plasticizer, the thickener, the dispersant, and the other additives other than the above-mentioned photosensitive component can be added to a photosensitive organic component if needed.
[0045] Although the compound which has an activity carbon-carbon double bond as a photosensitive monomer is mainly used, monofunctional and the multifunctional compound which have a vinyl group, an allyl group, an acrylate radical, a methacrylate radical, an acrylamide radical, etc. are used as a functional group. It is desirable to use a polyfunctional acrylate compound and/or a polyfunctional methacrylate compound especially.
[0046] While playing roles formed by the photoreaction, such as improvement in the physical properties of a hardened material, and adjustment of the viscosity of a paste, as an organic component which constitutes a photosensitive paste It is common that oligomer or a polymer is used together as a component which has the function to control the solubility of an unexposed paste., What has the frame of the carbon chain acquired by the polymerization or copolymerization of a component chosen from the compound with which these oligomer or polymers have a carbon-carbon double bond is used. As a monomer to copolymerize, unsaturated carboxylic acid etc. is useful and the photosensitive paste which can develop an unexposed part in an alkali water solution after sensitization can be given. thus, the acid number of the oligomer or the polymer which has acid radicals, such as a carboxyl group, in the obtained side chain -- desirable — 150-180, and controlling to become the range of 70-140 more preferably — it is desirable.
[0047] In order to use it as photosensitive oligomer or a polymer, the thing of the weight average molecular weight 500-100,000 which contains a carboxyl group and a partial saturation double bond in intramolecular is desirable. In order to introduce a partial saturation double bond, the method of carrying out the addition reaction of the ethylene nature unsaturated compound and acrylic-acid chloride which have a glycidyl group and an isocyanate radical, and the methacrylic-acid chloride to the oligomer or the polymer which has a carboxyl group in a side chain is applied. the ethylene nature partial saturation which makes photosensitivity the number of carboxyl groups, the oligomer, or the polymer for alkali water-solution development nature -- the base can be freely chosen by the reaction condition.
[0048] the case where it exposes to the photosensitive paste containing the above photosensitive components — a photosensitive component — a polymerization — and crosslinking reaction is carried out and it becomes insolubility at a developer. Therefore, a photopolymerization initiator needs to be added as a component which generates an activity radical and starts a radical polymerization and crosslinking reaction. Furthermore, a sensitizer is used with a photopolymerization initiator and it is (chemical sensitization) in raising sensibility ****, The wavelength range of a light effective in a reaction is expandable (spectral sensitization). These photopolymerization initiators and sensitizers can be used choosing them from a known compound group.

[0049] In order that glass powder may control the unnecessary photoreaction which occurs by the scattered light in the photosensitive paste included so much It is effective in order that adding an ultraviolet ray absorbent may obtain the septum pattern which was excellent in the configuration., The organic system color which has a high ultraviolet absorption multiplier in [wavelength] 350-450nm is preferably used for an ultraviolet ray absorbent. Specifically, an azo system color, a xanthene system color, a quinoline system color, a benzophenone system color, a triazine system color, etc. are raised. The addition of these organic system colors is 0.05 - 1 % of the weight preferably to glass powder. Although an organic system color may be mixed as one component of a photosensitive paste, the approach of processing glass powder with a color solution and carrying out the coat of the organic dye film to glass powder beforehand is also effective.
[0050] The antioxidant for preventing oxidation of the polymerization inhibitor for raising the thermal stability at the time of preservation and an acrylic copolymer if needed, other plasticizers, etc. can be added to a photosensitive paste.
[0051] An organic solvent is used in order to adjust the viscosity when applying a photosensitive paste to a glass substrate according to the method of application. As an organic solvent used at this time, the mixture of organic solvents containing one or more of sorts of these [methyl cellosolve, ethylcellosolve, butyl cellosolve, a methyl ethyl ketone dioxane, an acetone, a cyclohexanone, cyclopentanone, isobutyl alcohol, isopropyl alcohol, a tetrahydrofuran, dimethyl sulfoxide gamma-butyrolactone, etc. and] is used.
[0052] After a photosensitive paste usually prepares various components, such as glass particles, an ultraviolet-rays extinction agent, a photosensitive monomer, photosensitive oligomer or a polymer, a photopolymerization initiator, a sensitizer, other additives, and a solvent, so that it may become a predetermined presentation, with 3 rollers or a kneading machine, mixed distribution is carried out and it is produced by homogeneity. Although the viscosity of a paste is adjusted at an addition rate, such as glass particles, a photosensitive component, a thickener, an organic solvent, and a plasticizer, the range is 2000-200,000cps (centipoise) suitably. For example, for applying spreading to a glass substrate once with screen printing, and obtaining 10-20 micrometers of thickness, 50,000-200,000cps is desirable. When using 2000-5000cps, the blade coating-machine method, the die coating-machine method, etc. for a spin coat method, 10,000-20,000cps is desirable.
[0053] Septum formation by the pattern formation and baking using a photosensitive paste is performed as follows. First, a photosensitive paste is applied to a glass substrate. As the method of application, general approaches, such as screen printing, the bar coating-machine method, the roll coater method, the slit-die method, and a doctor blade method, can be used. Spreading thickness can be adjusted by choosing the count of spreading, the screen mesh of screen-stencil, and the viscosity of a paste.
[0054] After forming the glass substrate top which carried out surface treatment of the photosensitive paste if needed, or the dielectric layer and applying upwards, it exposes using an aligner. It is carried out through a photo mask so that exposure may be performed by the usual photolithography technique. In this case, any of the pro squeak tea exposing method which end and perform the approach or fixed spacing which sticks a photo mask to the spreading film front face of a photosensitive paste may be used.
[0055] The activity beam of light used for exposure has the most desirable ultraviolet rays, and a low pressure mercury lamp, a high pressure mercury vapor lamp, an ultrahigh pressure mercury lamp, a halogen lamp, etc. are used as the light source. It is common to use a pro squeak tea exposure machine using the parallel ray which made the ultrahigh pressure mercury lamp the light source. Although exposure conditions change with spreading thickness of a photosensitive paste, exposure is performed for 0.5 - 30 minutes cm, using the ultrahigh pressure mercury lamp of the output of 2 1-100mW /.
[0056] After exposure, although negatives are developed using the solubility difference over the developer of an exposure part and an unexposed part, dip coating, a spray method, the brush method, etc. are used in this case. The solution which can dissolve the organic component especially the photosensitive oligomer, or the polymer under photosensitive paste is used for a developer. Since the photosensitive oligomer or the polymer of the photosensitive paste used by this invention is characterized by having a carboxyl group in a side chain, it can be developed in an alkali water solution. Although the water solution of a sodium hydroxide, a sodium carbonate, and a calcium hydroxide etc. can be used as an alkali water solution, since the direction which used the organic alkali water solution tends to remove an alkali component at the time of baking, it is desirable. A common amine compound can be used as organic alkali. Specifically, tetramethylammonium hydroxide, trimethyl benzyl ammonium hydroxide, monoethanolamine, diethanolamine, etc. are raised. The concentration of an alkali water solution is usually 0.1 - 1 % of the weight more preferably 0.05 to 5% of the weight. If alkali concentration is too low, a fusible part will not be removed completely, but if alkali concentration is too high, there is a possibility of making exfoliating the pattern of the exposure section or eating away. As for the temperature at the time of development, it is desirable on production control to carry out at 20-50 degrees C.
[0057] The septum pattern formed through the process of exposure and development from the spreading film of a photosensitive paste is calcinated with a firing furnace next, an organic component is pyrolyzed and removed, melting of the glass-particles component is carried out to coincidence, and an inorganic septum is formed. Although a firing environments and temperature change with properties of a paste or a substrate, they are calcinated in ambient atmospheres, such as nitrogen and hydrogen, among air. Things are made using the firing furnace of a batch type, and the continuation mold firing furnace of a belt type as a firing furnace.
[0058] After carrying out the temperature up of the glass substrate with which the septum pattern was usually formed for calcinating a batch type at uniform velocity mostly over several hours from a room temperature to about

500 degrees C, 460-580 degrees C set up as a burning temperature are raised in 30 - 40 minutes, and it calcinates by holding for about 15 - 30 minutes. Since burning temperature must be lower than the glass transition point of the glass substrate to be used, an upper limit exists naturally. Burning temperature is too high, or if firing time is too long, defects, such as sagging, will occur in the configuration of a septum. Moreover, if the pyrolysis character of the photosensitive monomer contained in an organic component, photosensitive oligomer or a polymer, and various additives and the heat characteristic of a glass-particles component become disproportionate, the defect to which a septum colors it brown or a septum separates from a substrate will occur.

[0059] The plasma display of this invention is used for large-sized television, a computer screen, etc. suitable for plasma displays, such as a plasma-address-liquid-crystal display, again.

[0060] Hereafter, although this invention is concretely explained using an example, this invention is not limited to these. In addition, especially concentration (%) is weight % unless it refuses.

[0061]

[Example]

(Example 1) As a presentation (analysis value) of glass powder, the glass powder of 6.7% of lithium oxide, 22% of oxidization silicon, 32% of boron oxide, 3.9% of barium oxide, 19% of aluminum oxides, 2.2% of zinc oxides, 5.5% of magnesium oxides, and 4.1% of calcium oxides was used. The glass transition point of this glass powder was [530 degrees C and the coefficient of thermal expansion of 497 degrees C and glass softening temperature] 75x10-7/K. Beforehand, by the attractor, glass powder was used as impalpable powder and used as 2.6 micrometers of average particle systems, and un-spherical powder of a refractive index 1.58. It mixed to homogeneity so that it might become 8% to this glass powder about Cr-Fe-nickel mixing impalpable powder. Furthermore, to this glass powder, 0.08% of azo system organic dye Sudan IV was dissolved in the acetone, the dispersant was added, and it stirred to homogeneity by the homogenizer, and glass powder was added in this solution, the rotary evaporator was used for homogeneity after distribution / mixing, it dried at the temperature of 150-200 degrees C, and the acetone was evaporated.

[0062] On the other hand, stirring [mixed so that it might become a solution 40%, and] a solvent (gamma-butyrolactone) and a polymer, it heated to 60 degrees C and all the polymers were dissolved in homogeneity. The photosensitive polymer of the weight average molecular weight 43,000 to which the addition reaction of the 0.4Eq glycidyl methacrylate was carried out to the carboxyl group of the copolymer which consists of 40% of methacrylic acid, 30% of methyl methacrylate, and 30% of styrene, and the acid number 95 was used for the used polymer. Subsequently, a solution is cooled to a room temperature, and the photosensitive monomer (MGP400), the photopolymerization initiator (IC-369), and the sensitizer (DETX-S) were added, and it was made to dissolve. Then, this solution was filtered using the filter of 400 meshes, and the organic vehicle was produced.

[0063] 3 rollers mixed and distributed glass powder and an organic vehicle, and the photosensitive paste was prepared. The amounts (weight section) of each component contained in a photosensitive paste were glass powder 70, the photosensitive polymer solution 37.5, the photosensitive monomer 15, the photopolymerization initiator 4.8, and a sensitizer 4.8.

[0064] This photosensitive paste was applied to homogeneity by the screen-stencil which used the screen of 325 meshes on 100mm angle glass substrate. In order to avoid generating of a pinhole etc. on the spreading film, a repetition deed and adjustment of film thickness were performed for spreading and desiccation several times. Intermediate desiccation was performed for 10 minutes at 80 degrees C. Then, at 80 degrees C, it held for 90 hours and dried. The spreading film thickness after desiccation was 170 micrometers.

[0065] Then, ultraviolet-rays exposure was carried out with the ultrahigh pressure mercury lamp of 20mW[/cm] 2 output from the top face using the chromium mask of a negative mold with a 150-micrometer pitch and a line breadth of 20 micrometers. Light exposure was 1 J/cm2.

[0066] Next, negatives were developed by pouring in a shower 0.2% of water solution of the monoethanolamine held at 35 degrees C for 90 seconds, and it rinsed using the shower spray after that, the tooth-space part which has not carried out photo-curing was removed, and the stripe-like septum pattern was formed on the glass substrate.

[0067] Thus, the black septum has been formed when the obtained septum pattern was calcinated for 30 minutes at 560 degrees C in air. When the cross-section configuration of the formed septum was observed with the electron microscope, it was height [of 120 micrometers], line breadth [of a septum center section / of 35 micrometers] (half-value width), and pitch 150micrometer. the Y value 25, the color coordinate value x, and y -- respectively -- 0. -- 32 or 0.34 septa were obtained, there was also neither peeling nor an open circuit, and it was good.

[0068] After forming the fluorescent substance layer on the substrate with which the electrode, the dielectric, and the black septum were formed and doubling with a front plate, it sealed, and gas charging was carried out, the drive circuit was connected, and the plasma display was produced. It displayed on this panel by impressing an electrical potential difference. The contrast ratio was measured from the brightness at the time of complete lighting, and the reflection factor at the time of putting out lights. The contrast ratio was measured using photometry opportunity MCPD-200 by the Otsuka electronic company. a contrast ratio -- 100:1 it was .

[0069] (Example 2) The presentation (analysis value) of glass powder used the glass powder of 4.5% of lithium oxide, 15% of oxidization silicon, 30% of boron oxide, 11% of barium oxide, 11% of aluminum oxides, 6.7% of zinc oxides, 9.1% of magnesium oxides, and 8.6% of calcium oxides. The glass transition point of this glass powder was 486 degrees C, and glass softening temperature was 523 degrees C. The coefficients of thermal expansion between 50-400 degrees C are 87x10-7/K. To this glass powder, Fe-Co mixing powder was mixed 5%. A little powder was the color which gray cut. Others repeated the example 1. When calcinated, pitch 150micrometer, height of 130 micrometers, the

half-value width of 30 micrometers, and a black septum were obtained. Y value of this septum -- 20 -- it is -- a chromaticity coordinate x and y -- respectively -- 0. -- it was 33 and 0.36. The contrast of a plasma display was 120:1.

[0070] (Example 3) Cr powder was not put into glass powder, but the example 1 was repeated except having changed the photosensitive monomer into GX and having changed the organic component into the photosensitive polymer solution 37.5, the photosensitive monomer 15, the photopolymerization initiator 4.8, and the sensitizer 4.8. When calcinated, pitch 150micrometer, height of 130 micrometers, the half-value width of 30 micrometers, and a black septum were obtained. Y value of this septum -- 20 -- it is -- a chromaticity coordinate x and y -- respectively -- 0. -- it was 33 and 0.36. The contrast of a plasma display was 120:1.

[0071] (Example 1 of a comparison) The example 1 was repeated, without putting Cr powder into glass powder. When calcinated, the septum of pitch 150micrometer, height of 125 micrometers, the half-value width of 30 micrometers, and gray was obtained. Y value of this septum was 50. The contrast of a plasma display was 50:1.

[0072] (Example 2 of a comparison) The powder which put Fe-Co-nickel mixing powder into glass powder 28% was produced. Powder was presenting black. Others repeated the example 1. However, pattern resolution was bad, and the viscosity of a paste rose, and gelation was accepted. Although peeling was accepted at almost all places when calcinated, the septum which has pitch 150micrometer, height of 140 micrometers, and with a half-value width [of 50 micrometers] black was formed partially. Y value of this septum was 3. However, it was not able to evaluate as a plasma display.

[0073]

(Explanation of an abbreviated name)

MGP400: X2-N-CH(CH3)-CH2-(O-CH2-CH (CH3)) n-N-X2 It is here, X: -CH2-CH(OH)-CH2 O-CO-C(CH3) =CH2 n=2-10GX : X2-N-CH2-Ph-CH2-N-X2 It is here and is X:-CH2-CH(OH)-CH2 O-CO-C(CH3) =CH2IC-369:Irgacure-369 (Ciba-Geigy product).

2-benzyl-2-dimethylamino-1-(4-mol FORINOFU ENIRU) butanone-1 DETX-S:2, 4-diethyl thioxan ton [0074]

[Effect of the Invention] The RAZUMA display which gets twisted in this invention and has a black septum required for ** and the high improvement in color purity of contrast can be obtained easily.

[Translation done.]